IN THE CLAIMS:

1.   (Original)   A system for synchronizing dependencies upon a set of persistent consistency point images (PCPIs) among a set of computers, the system comprising:

        means for identifying a dependency upon the set of PCPIs;

        means for creating a set of soft locks, each soft lock in the set of soft locks associated with each of the PCPIs in the set of PCPIs; and

        means for transmitting the set of soft locks to one or more of the set of computers.

2.   (Original)   The system of claim 1 wherein the set of computers comprises a set of storage appliances.

3.   (Original)   The system of claim 1 wherein each soft lock comprises a PCPI identifier field, a type field and a string field.

4.   (Original)   The system of claim 3 wherein the string field comprises user visible information.

5.   (Original)   The system of claim 3 wherein the string field identifies an application that depends upon the PCPI associated with the soft lock.

6.   (Original)   The system of claim 3 wherein the type field identifies a type of data in the string field.

7.   (Original)   The system of claim 6 wherein the type of data comprises an owner name.

8.   (Original)   The system of claim 6 wherein the type of data comprises a destination path.

9.   (Original)   The system of claim 6 wherein the type of data comprises a qtree name.

10.   (Original)   The system of claim 1 wherein the means for transmitting the set of soft locks to one or more of the set of computers further comprises:

     means for transmitting the set of soft locks before an asynchronous mirroring process; and

     means for transmitting the set of soft locks after an asynchronous mirroring process.

11.   (Original)   A method for synchronizing dependencies upon a set of persistent consistency point images (PCPIs) among a set of computers, the method comprising the steps of:

     identifying a dependency upon the set of PCPIs;

     creating a set of soft locks, each soft lock in the set of soft locks associated with each of the PCPIs in the set of PCPIs; and

     transmitting the set of soft locks to one or more of the set of computers.

12.   (Original)   The method of claim 1 wherein the set of computers comprises a set of storage appliances.

13.   (Original)   The method of claim 1 wherein each soft lock comprises a PCPI identifier field, a type field and a string field.

14.   (Original)   The method of claim 13 wherein the string field comprises user visible information.

15.   (Original)   The method of claim 13 wherein the string field identifies an application that depends upon the PCPI associated with the soft lock.

1   16.   (Original)   The method of claim 13 wherein the type field identifies a type of

2   data in the string field.

1   17.   (Original)   The method of claim 16 wherein the type of data comprises an

2   owner name.

1   18.   (Original)   The method of claim 16 wherein the type of data comprises a des-

2   tination path.

1   19.   (Original)   The method of claim 16 wherein the type of data comprises a qtree

2   name.

1   20.   (Original)   The method of claim 1 wherein the step of transmitting the set of

2   soft locks to one or more of the set of computers further comprises the steps of:

3   transmitting the set of soft locks before an asynchronous mirroring process; and

4   transmitting the set of soft locks after an asynchronous mirroring process.

1   21.   (Original)   A storage system for use in a storage system environment for

2   communicating dependencies upon a set of persistent consistency point images (PCPIs)

3   among a set of storage systems, the storage system comprising:

4   a storage operating system having a file system that implements PCPIs;

5   an application executing on the storage system, the application adapted to imple-

6   ment a soft lock to communicate a dependency with a specific PCPI; and

7   a network protocol module of the storage operating system, the network protocol

8   module operatively interconnected with the application and adapted to transfer the soft

9   lock to one or more storage systems in the set of storage systems.

1   22.   (Original)   The storage system of claim 21 wherein the application comprises

2   an asynchronous mirroring application.

1   23.   (Original)   The storage system of claim 21 wherein the soft lock comprises a

2   PCPI identifier field, a type field, and a string field.

1   24.   (Original)   The storage system of claim 23 wherein the string field comprises

2   user visible information.

1   25.   (Original)   The method of claim 23 wherein the string field identifies an ap-

2   plication that depends upon the PCPI associated with the soft lock.

1   26.   (Original)   The method of claim 23 wherein the type field identifies a type of

2   data in the string field.

1   27.   (Original)   The method of claim 26 wherein the type of data comprises an

2   owner name.

1   28.   (Original)   The method of claim 26 wherein the type of data comprises a des-

2   tination path.

1   29.   (Original)   The method of claim 26 wherein the type of data comprises a qtree

2   name.

1   30.   (Original)   A method for propagating soft locks through a cascaded chain of

2   storage systems comprising at least a downstream storage system and an upstream stor-

3   age system, the method comprising the steps of:

4   identifying a set of persistent consistency point images on the upstream storage

5   system that require a soft lock to be set;

6   creating soft locks for the identified set of persistent consistency point images;

7   sending the created soft locks to the upstream storage system; and

8   performing an asynchronous mirroring process to mirror local data to the down-
9 stream storage system.

1 31.   (Original)   The method of claim 30 further comprising the steps of:
2   determining if a new persistent consistency point image exist on the downstream
3 storage system;
4   identifying, in response to a new persistent consistency image existing on the
5 storage system, a set of additional soft locks on the downstream storage system; and
6   sending the additional set of soft locks to the upstream storage system.

1 32.   (Original)   The method of claim 30 wherein the soft lock comprises a data
2 structure having an entry identifying a resource identifier and an identifier of a locking
3 data set.

1 33.   (Original)   The method of claim 32 wherein a resource identifier identifies a
2 persistent consistency point image that the soft lock protects.

1 34.   (Original)   The method of claim 32 wherein the identifier of a locking dataset
2 identifies a resource on a downstream system that requires the use of the persistent con-
3 sistency point image identified in the resource identifier.

1 35.   (Original)   The method of claim 30 wherein the step of identifying a set of
2 persistent consistency point images on the upstream storage system that requires a soft
3 lock to be set further comprises the steps of:
4   identifying a set of persistent consistency point images that are in common be-
5 tween the upstream storage system and the downstream storage system; and
6   identifying a set of persistent consistency point images that have a soft lock set
7 from one or more storage systems located downstream from the downstream storage sys-
8 tem.

36.   (Original)   The method of claim 30 wherein the downstream storage system comprises a storage system to which mirrored data is transferred.

37.   (Original)   The method of claim 30 wherein the upstream storage system comprises a storage system from which mirrored data is transferred.

38.   (Original)   A cascaded set of storage systems interconnected via one or more networks, each of the storage systems comprising:

a storage operating system executing, the storage operating system including a mirroring application adapted to create and maintain soft locks on the storage systems of the cascaded set of storage systems.

39.   (Original)   The cascaded set of storage systems of claim 38 wherein the mirroring application implements a volume-based asynchronous mirroring process.

40.   (Original)   The cascaded set of storage systems of claim 38 wherein the mirroring application implements a qtree-based asynchronous mirroring process.

41.   (Original)   The cascaded set of storage systems of claim 38 wherein each of the soft locks comprises a data structure having an entry defining a resource identifier and an entry identifying a locking dataset.

42.   (Original)   The cascaded set of storage systems of claim 38 wherein the mirroring application is further adapted to propagate the soft locks to one or more of the storage systems in the cascaded set of storage systems.

43.   (Original)   A storage system for use in a cascaded set of storage systems having at least an upstream storage system, the storage system comprising:

means for identifying a set of persistent consistency point images on the upstream storage system that require a soft lock to be set;

⁵   means for creating soft locks for the identified set of persistent consistency point

⁶ images; and

⁷   means for sending the created soft locks to the upstream storage system.

¹ 44.   (Original)   The storage system of claim 43 further comprising means for per-

² forming an asynchronous mirroring process to mirror local data to a downstream storage

³ system.

¹ 45.   (Original)   The storage system of claim 44 wherein the storage system is

² operatively interconnected with the downstream storage system via a network.

¹ 46.   (Original)   The storage system of claim 44 wherein the storage system is con-

² nected to the upstream storage system and the downstream storage system via a network.

¹ 47.   (Original)   The storage system of claim 43 further comprising means for per-

² forming an asynchronous mirroring process to mirror local data to the downstream stor-

³ age system.

¹ 48.   (Original)   A computer readable medium, including program instructions exe-

² cuting on a storage system in a cascaded set of storage systems having at least an up-

³ stream storage system and a downstream storage system, the computer readable medium

⁴ including instructions for performing the steps of:

⁵   identifying a set of persistent consistency point images that are in common be-

⁶ tween the upstream storage system and the downstream storage system; and

⁷   identifying a set of persistent consistency point images that have a soft lock set

⁸ from one or more storage systems located downstream from the downstream storage sys-

⁹ tem;

¹⁰   creating soft locks for the identified set of persistent consistency point images;

¹¹   sending the created soft locks to the upstream storage system; and

12   performing an asynchronous mirroring process to mirror local data to the down-

13 stream storage system.

1 49. (Original) The computer readable medium of claim 19 wherein local data

2 comprises data stored on storage devices associated with a storage system executing the

3 computer readable medium.

1 50. (Previously Presented) A method for synchronizing persistent consistency

2 point images among a plurality of computers, the method comprising the steps of:

3   identifying a set of persistent consistency point images on a first computer of the

4 plurality of computers;

5   creating soft locks for the identified set of persistent consistency point images; and

6   sending the created soft locks to the plurality of computers.

1 51. (Previously Presented) The method of claim 50 wherein , in the identifying

2 step, the set of persistent consistency point images is identified, in the identifying step, on

3 an upstream storage system of the plurality of computers.

1 52. (Previously Presented) The method of claim 50 wherein, in the sending

2 step, the created soft locks are sent, to an upstream storage system of the plurality of

3 computers.

1 53. (Previously Presented) The method of claim 50 wherein, in the identifying

2 step, persistent consistency point images that require a soft lock to be set are identified.

1 54. (Previously Presented) The method of claim 50 further comprising:

2   performing an asynchronous mirroring process to mirror local data to a selected

3   computer of the plurality of computers, the soft locks maintaining consistency of the data

4   on the plurality of computers.

1   55.   (Previously Presented)   The method of claim 54 wherein, in the mirroring

2   step, the local data is mirrored to a down stream storage system of the plurality of com-

3   puters.

1   56.   (Previously Presented)   A method of synchronizing dependencies upon a set

2   of persistent consistency point images, comprising:

3   identifying a set of persistent consistency point images that are in common be-

4   tween an upstream storage system and a downstream storage system; and

5   identifying a set of persistent consistency point images that have a soft lock set

6   from one or more storage systems located downstream from the downstream storage sys-

7   tem;

8   creating soft locks for the identified set of persistent consistency point images;

9   and

10   sending the created soft locks to the upstream storage system.

1   57.   (Previously Presented) The method of claim 56 further comprising:

2   performing an asynchronous mirroring process to mirror local data to the down-

3   stream storage system.

1   58.   (Previously Presented) A system for synchronizing dependencies upon a set of

2   persistent consistency point images, comprising:

3   means for identifying a set of persistent consistency point images that are in

4   common between an upstream storage system and a downstream storage system; and

means for identifying a set of persistent consistency point images that have a soft lock set from one or more storage systems located downstream from the downstream storage system;

means for creating soft locks for the identified set of persistent consistency point images; and

means for sending the created soft locks to the upstream storage system.

59. (Previously Presented) The system according to claim 58 further comprising:

means for performing an asynchronous mirroring process to mirror local data to the downstream storage system.

60. (New) A computer data storage system cluster comprising:

a primary storage system including an active file system;

a persistent consistency point image (PCPI) consisting of a point-in-time image of the active file system;

at least one mirror image of the PCPI, the mirror image being stored on a downstream storage system; and

at least one soft lock issued by the downstream storage system in response to an application being dependent upon the PCPI, the soft lock consisting of a data structure configured to prevent changes to the PCPI.

61. (New) The computer data storage system cluster of claim 60 comprising:

a cascade of mirrored images of the PCPI stored on a plurality of data storage systems in the cluster; and

4   wherein the at least one soft lock comprises a set of soft locks that are

5   communicated from downstream storage systems in the cluster to upstream stor-

6   age systems in the cluster.

1   62.   (New) The computer data storage system cluster of claim 60 comprising:

2   wherein the soft lock is transmitted from the downstream storage system

3   to the primary storage system over a data link.

1   63.   (New) The computer data storage system cluster of claim 60 comprising:

2   a field in the soft lock storing data identifying an owner of the soft lock

3   wherein the owner comprises the application being dependent upon the PCPI.

1   64.   (New) A method of managing data on a cluster of computer data storage

2   systems, the method comprising:

3   writing a persistent consistency point image (PCPI) on a primary storage

4   system, the PCPI consisting of a point-in-time image of an active file system op-

5   erating on the primary storage system;

6   writing at least one mirror image of the PCPI on a downstream storage

7   system; and

8   issuing at least one soft lock by the downstream storage system in re-

9   sponse to an application being dependent upon the PCPI, the soft lock consisting

10   of a data structure configured to prevent changes to the PCPI.

1   65.   (New) The method of claim 64 comprising:

2   writing a cascade of mirrored images of the PCPI on a plurality of data

3 storage systems in the cluster; and

4   wherein the at least one soft lock comprises a set of soft locks that are

5 communicated from downstream storage systems in the cluster to upstream stor-

6 age systems in the cluster,

1 66. (New) The method of claim 64 comprising:

2   transmitting the soft lock from the downstream storage system to the pri-

3 mary storage system over a data link.

1 67. (New) The method of claim 64 comprising:

2   storing data in the soft lock, the data identifying an owner of the soft lock

3 wherein the owner comprises the application being dependent upon the PCPI.

1 68. (New) A computer readable medium, including program instructions exe-

2 cuting on a storage system in a cascaded set of storage systems having at least an

3 upstream storage system and a downstream storage system, the computer readable

4 medium including instructions for performing the steps of:

5   writing a persistent consistency point image (PCPI) on a primary storage

6 system, the PCPI consisting of a point-in-time image of an active file system op-

7 erating on the primary storage system;

8   writing at least one mirror image of the PCPI on a downstream storage

9 system; and

10   issuing at least one soft lock by the downstream storage system in re-

11 sponse to an application being dependent upon the PCPI, the soft lock consisting

12 of a data structure configured to prevent changes to the PCPI.

69.   (New) A computer data storage system cluster comprising:

means for writing a persistent consistency point image (PCPI) on a primary storage system, the PCPI consisting of a point-in-time image of an active file system operating on the primary storage system;

means for writing at least one mirror image of the PCPI on a downstream storage system; and

means for issuing at least one soft lock by the downstream storage system in response to an application being dependent upon the PCPI, the soft lock consisting of a data structure configured to prevent changes to the PCPI.